A NEW GENUS AND SIX NEW SPECIES OF DYTISCIDAE (COLEOPTERA) FROM UNDERGROUND WATERS IN THE YILGARN PALAEODRAINAGE SYSTEM OF WESTERN AUSTRALIA

C. H. S. WATTS & W. F. HUMPHREYS

WATTS, C. H. S. & HUMPHREYS, W. F. 2001. A new genus and six new species of Dytiscidae (Coleoptera) from underground waters in the Yilgarn palaeodrainage system of Western Australia. *Records of the South Australian Museum* **34**(2): 99–114.

A new genus and six new species of stygobitic beetles of the family Dytiscidae, subfamily Hydroporinae, from relatively shallow calcrete aquifers in Western Australia, are described and figured. The new genus (*Nirripirti*) and species (*N. hinzeae*) are in the tribe Hydroporini, whilst the remaining species belong in the tribe Bidessini, namely, *Nirridessus challaensis, N. masonensis, N. fridaywellensis, N. pinnaclesensis* and *Tjirtudessus raesidensis*. The species are members of a rich, recently discovered, relictual stygofauna, predominantly of Crustacea and Oligochaeta, inhabiting calcretes lying along palaeodrainage channels. The new genus represents a significant taxonomic extension of the Australian stygobitic Dytiscidae, being the first Australian stygobitic member of its tribe. The new species represent a significant geographic extension of Australian stygobitic Dytiscidae into a new palaeodrainage channel unconnected with any previously examined. Each calcrete area examined contained a distinct assemblage of beetles often with two species in sympatry.

C. H. S. Watts, South Australian Museum, North Terrace, Adelaide, South Australia 5000.
W. F. Humphreys, Western Australian Museum, Francis Street, Perth, Western Australia 6000.
Manuscript received 1 February 2001.

The presence of an extensive stygofauna consisting of Crustacea, Oligochaeta and beetles of the family Dytiscidae living in near-surface aquifers of the Western Desert areas of Western Australia has recently been documented by us (Watts & Humphreys 1999, 2000). In this paper we report on significant geographic and taxonomic extensions to the known fauna of Dytiscidae.

In our two previous papers we described eleven species of Dytiscidae belonging to three genera all in the subfamily Hydroporinae. One genus, *Kintingka*, known from only one female specimen, could not unequivocally be placed in a tribe but the other two genera possessed the defining synapomorphy for the tribe Bidessini—two-segmented parameres. In the most recent collection reported on here most specimens again belonged in the same two Bidessine genera, *Tjirtudessus* and *Nirridessus*. A series of relatively large specimens from one location, however, had single segmented parameres and other morphological characters in both adults and associated larvae which place them in the tribe Hydroporini, the first underground members of this tribe to be recorded from Australia, although they are a major component of the stygodytiscidae worldwide (Spangler 1986).

The Raeside palaeodrainage system (Fig. 40), from which some of the latest specimens were collected, is unconnected to the drainage systems from which we earlier reported underground Dytiscidae (Watts & Humphreys 2000: Fig. 38); this represents a significant extension of the geographical, as well as the taxonomic range, of the Yilgarn stygofauna. As for the systems reported in our earlier papers, numerous specimens of Crustacea—bathynellids, harpacticoid and cyclopoid copepods, ostracods and oniscid isopods—and some Oligochaeta and Hydracarina were collected. As before, the beetles and larger stygofauna were restricted to aquifers in areas of calcrete, as is the stygofauna found in the northern parts of the Western Shield (Poore & Humphreys 1998; Humphreys 1999 in press). But, unlike our previous observation that the stygofauna was found only in narrow bores, thus seemingly restricted to 'closed' aquifers (Watts & Humphreys 2000), in this recent survey stygofauna were found to be common in formed-wells dug for water as well as in narrow boreholes drilled for geological purposes, water monitoring, water pumping or aquifer assessment.

Methods

The collection methods and measurements of physicochemical parameters in the water were the same as in our previous papers (Watts & Humphreys 1999, 2000).

Abbreviations used:

BES Prefix for field numbers, WAM Biospeleology.

SAMA South Australian Museum, Adelaide.

WAM Western Australian Museum, Perth.

Systematics

Key to Australian Species of Stygobitic Dytiscidae

1. — Profemur with small peg-like structure close to base; metatibia approximately the same width throughout .... *Nirripirti hinzeae* sp. nov.
   — Profemur lacking such a structure; metatibia narrow at base then strongly expanding towards apex 2
2. — Body length approximately 1.0 mm; legs stout, without swimming-hairs on fore- and midlegs ..... *Kintingka kurutjutu* Watts and Humphreys
   — Body length > 1.2 mm; legs normal, all with swimming-hairs 3
3. — Third and fourth (apical) segments of labial palpi subequal in length; setae on hind edge of mesofemur not greatly stronger than those on mesotrochanter; length > 3.0 mm (*Tjirtudessus*) 14
   — Third segment of labial palpi half to two-thirds length of apical; setae on hind edge of mesofemur near base much stronger than those on mesotrochanter or elsewhere on femur; length 1.3–3.2 mm. (*Nirridessus*) 4
4. — Pronotal plicae strong, well marked 5
   — Pronotal plicae weak, difficult to trace 6
5. — Length of first two segments of metatarsi > rest; eye remnant present; parameres with long apical lobe .... *N. pulpa* Watts and Humphreys
   — Length of first two segments of metatarsi =< rest; without eye remnant; parameres with small apical lobe .... *N. morgani* Watts and Humphreys
6. — Length => 2.9 mm; eye remnant present; group of six spines close to base of mesofemur on hind edge .... *N. bigbellensis* Watts and Humphreys
   — Length < 2.6 mm; with or without eye remnant; spines on mesofemur spread out along hind edge or if restricted to base four or fewer 7
7. — Row of larger punctures adjacent to suture; metatrochanters rounded 8
   — Without sutural punctures, metatrochanters bluntly pointed 9
8. — Length 2.2–2.3 mm; with eye remnant .. *N. windarraensis* Watts and Humphreys
   — Length 1.3–1.5 mm; without eye remnant ..... *N. lapostaae* Watts and Humphreys
9. — Apical segment of antenna approximately the same size as penultimate, segments 3 and 4 subequal; pro- and mesotarsi strongly expanded, approximately equal in size .. .. *Nirridessus challaensis* sp. nov.
   — Apical segment of antennae approximately 1.5x length of penultimate, segment 3 > segment 4; protarsus moderately or weakly expanded, much more so than mesotarsi 10
10. — Mesofemur with four to five spines spread out along hind edge in basal half .... *Nirridessus masonensis* sp. nov.
    — Mesofemur with two to four strong spines clustered on hind edge close to base.. 11
11. — Mesofemur with four spines near base; segments 2 and 3 of antennae similar in size, apical segment approximately 1.5x penultimate in length ..... *Nirridessus cueensis* Watts and Humphreys
    — Mesofemur with two to three strong spines on hind edge near base; segment 2 of antenna large and oval, segment 3 much smaller and thinner, apical segment approaching 2x length of penultimate 12
12. — Mesofemur with two strong spines on hind edge near base; apical segment of paramere with two finger-like projections ..... *Nirridessus pinnaclesensis* sp. nov
    — Mesofemur with three strong spines on hind edge near base; apical segment of paramere with one finger-like projection 13

13. — Apical lobe of paramere overlapping rest of apical segment; central lobe pointed; protarsus weak, similar in size to mesotarsi; segment 3 of antenna >> segment 4 in length *Nirridessus fridaywellensis* sp. nov.
— Apical lobe of paramere well separated from rest of apical segment; central lobe blunt at tip; segment 3 of antenna > segment 4 in length; protarsus moderately expanded, mesotarsus less so ..... *Nirridessus hinkleri* Watts and Humphreys

14. — Pro- and mesotarsi strongly expanded; apical four segments of antennae noticeably thinner than others ..... *Tjirtudessus magnificus* Watts and Humphreys
— Pro- and mesotarsi only moderately expanded; apical four segments of antennae not narrower than others 15

15. — Length > 3.8 mm; pronotum a little narrower than elytra 16
— Length < 3.8 mm; pronotum wider than elytra ..... *Tjirtudessus eberhardi* Watts and Humphreys

16. — Metatrochanters rounded at tip; central lobe of aedeagus straight, tip pointed; with small eye remnant ..... *Tjirtudessus raesideensis* sp. nov.
— Metatrochanters pointed at tip; central lobe of aedeagus twisted, tip knobbed; without eye remnant ..... *Tjirtudessus hahni* Watts and Humphreys

Tjirtudessus Watts and Humphreys, 1999

Tjirtudessus raesideensis sp. nov.
(Figs 1–7)

Types

Holotype: m. 'BES 8354, Salt Well, Lake Mason Station, 27°32'24"S, 119°37'27"E, 24/6/00, coll W. F. Humphreys, S. Hinze' in spirit, WAM 27601.

Paratypes: 32, as for holotype, 19 SAMA, 13 WAM 27602–27615; 22, ditto except 'BES 8355', 10 SAMA, 12 WAM 27616–27627; 2, ditto except 'BES 8350', SAMA.

Description (number examined, 57)

Habitus. Length 3.5–4.0 mm; relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about half length of elytron.

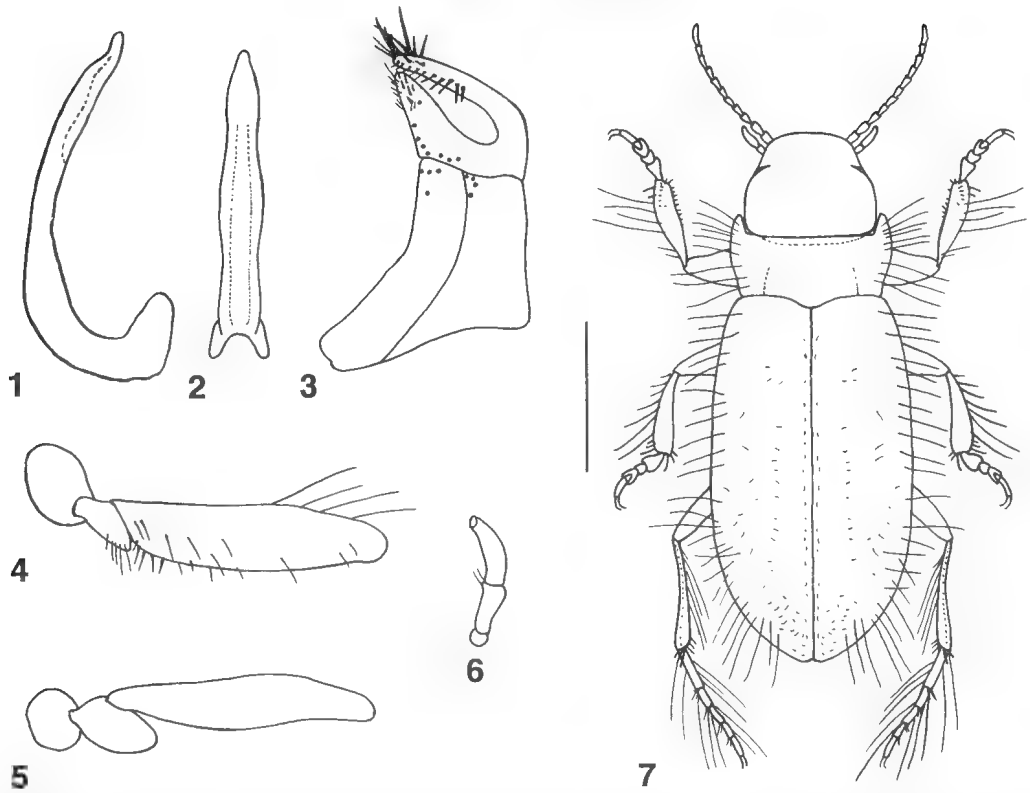
Head. Narrower than elytra; smooth, reticulation very weak, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to narrowly-oval structure. Antenna relatively stout; basal two segments cylindrical, third segment as long but narrower and narrowing towards base, next seven subequal but becoming progressively shorter, apical segment a bit longer than penultimate; each segment, except segment 1, with some very small setae on inside apically (Fig. 7). Maxillary palpus elongate, apical segment a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated. Labial palpus elongate, apical two segments subequal, tip weakly bifid, penultimate segment with two setae near tip (Fig. 6).

Pronotum. Almost as wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles acute; smooth, with sparse, very weak punctures and a row of stronger punctures along front margin; basal plicae moderately marked, straight, reaching to about halfway along pronotum, slightly excavated inwards; with row of long setae laterally, denser towards front.

Elytra. Not fused, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures, row of widely spaced larger punctures close to inner edge; numerous setiferous micropunctures towards apex and near base; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron broad in anterior fifth, then rapidly narrowing to be virtually absent over rest of elytron.

Ventral surface. Prothoracic process strongly narrowed between coxae, not reaching mesosternum, apical half narrow, almost parallel-sided, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply triangular in front in midline, wings very narrow, broadly rounded in midline behind. Metacoxal plates large, metacoxal lines moderately widely spaced, reaching to about halfway to metasternum, evenly diverging; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively narrow, inner edge



FIGURES 1–7. *Tjirtudessus raesideensis*: 1, lateral view of central lobe of aedeagus; 2, ditto dorsal view; 3, paramere; 4, mesotrochanter and mesofemur; 5, metatrochanter and metafemur; 6, labial palpus; 7, dorsal view. Scale bar represents 1 mm.

straight, outer edge bowed, widest past middle where it is about 3x its basal width; protarsi expanded, first segment broad narrowing at base, second segment a little narrower about one-third length of first, third segment as long as first but much narrower and very deeply bifid, fourth segment very small and hidden within lobes of third segment, apical segment narrow, cylindrical, about length of third, segments 1 to 3 with very dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with row of eight to nine relatively weak setae along hind edge in basal half (Fig. 4); mesotarsi similar to protarsi. Metatrochanter tip rounded (Fig. 5); metafemur elongate, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, basal segment longest, apical segment much longer than fourth, segments 1 and 2 in combination about as long as others; claws weak.

Male. Antennae a little stouter; pro- and mesotarsi a little stouter. Median lobe of aedeagus variable in width along shaft, tip bluntly pointed; paramere broad, apical segment with long, narrow, apical lobe well separated from rest of segment (Figs 1–3).

Etymology

Named after the palaeodrainage system in which it was collected.

Remarks

In size and in the relatively narrow pronotum, *T. raesideensis* most nearly resembles *T. hahni* but differs from this species in the more gracile fore- and midlegs, thinner antennae, more rounded tips to the metatrochanters and the presence of a small eye remnant which is absent in *T. hahni*. The aedeagi of the two species are quite different. It is smaller than *T. magnificus* with a narrower prothorax and much weaker pro- and mesotarsi. *Tjirtudessus eberhardi* is a little smaller with a broad pronotum and different aedeagus.

Nirridessus Watts and Humphreys, 1999

Nirridessus challaensis sp. nov.
(Figs 8–14)

Types

Holotype: m. 'BES 8319, Nyung well, Challa Station, 27°59'18"S, 118°31'03"E, 22/6/00, coll W. F. Humphreys, S. Hinze', slide mounted, in spirit, WAM 27668.

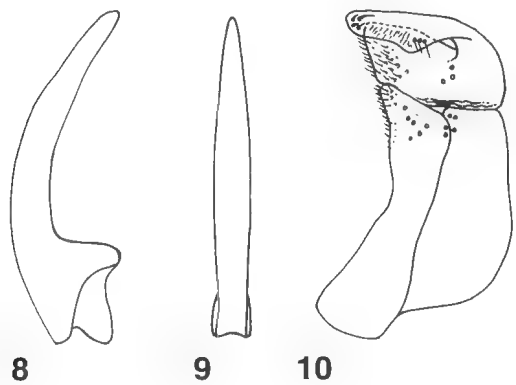
Paratypes: 1, as for holotype, WAM 27669; 3, 'BES 8346, Nyung well, Challa Station, 27°59'18"S, 118°31'03"E, 23/6/00, coll W. F. Humphreys, S. Hinze', 2 SAMA, 1 WAM 27671.

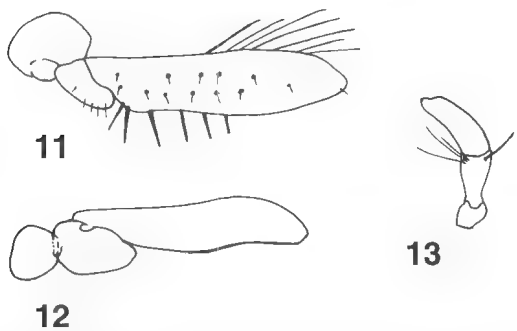
Description (number examined, 5)

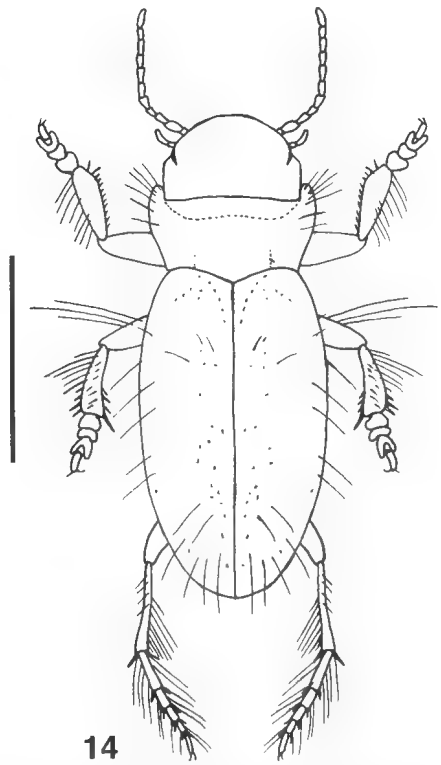
Habitus. Length 2.3–2.5 mm; relatively flat, moderately constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about half length of elytron.

Head. Large, nearly as wide as elytra; smooth, weakly reticulate, a few small scattered punctures more numerous near antennal bases; subparallel in posterior half; eye remnant reduced to small triangular to oval area beneath head. Antenna relatively stout; basal segment cylindrical, second weakly ovoid, third segment about same length but narrower at base, fourth slightly smaller, next six subequal, apical segment a bit longer and slightly narrower than penultimate; each segment, except segments 1 and 4, with some very small setae on inside apically (Fig. 14). Maxillary palpus, elongate, apical segment large, about length of segments 1 to 3 combined, an oblique row of long setae on outer side near tip, tip truncated. Labial palpus moderate, apical segment longer that penultimate, tip weakly bifid, penultimate segment with small papilla near tip bearing two setae (Fig. 13).

Pronotum. Broad, as wide as elytra; anteriolateral angles projecting strongly forward; base moderately strongly narrowed, posterolateral angles acute; smooth, with sparse, very weak punctures more numerous towards the front margin; basal plicae very weak, slanting inwards, reaching to about halfway along pronotum, slightly excavated inwards; with row of long setae laterally, denser towards front.







FIGURES 8–14. *Nirridessus challaensis*: 8, lateral view of central lobe of aedeagus; 9, ditto dorsal view; 10, paramere; 11, mesotrochanter and mesofemur; 12, metatrochanter and metafemur; 13, labial palpus; 14, dorsal view. Scale bar represents 1 mm.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with scattered punctures larger laterally, row of small serial punctures in centre of elytron; setiferous micropunctures in basal fifth; a few scattered punctures with long setae, more frequent towards sides and apex. Epipleuron rather narrow in anterior fifth, then rapidly narrowing to be virtually absent over rest of elytron.

Ventral surface. Prothoracic process strongly narrowed between coxae, not reaching metasternum, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae nearly in contact at midline. Metasternum sharply triangular in front in midline, wings very narrow, broadly rounded in midline behind. Metacoxal plates large, metacoxal lines weak, widely spaced, reaching to about halfway to metasternum, diverging in anterior two-thirds; virtually impunctate except for a few towards midline; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines distinct, ventrites 3 to 5 mobile, virtually impunctate except for some small seta-bearing punctures towards anterior edge of ventrites, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively narrow, edges straight, widest near apex where it is about 3x its basal width; protarsi moderately expanded, first segment broadly oval, second segment as broad, about one-third length of first, third segment as long as first but narrower and very deeply bifid, fourth segment very small and hidden within lobes of third segment, apical segment narrow, cylindrical, about length of third, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter oval with row of fine setae on inner edge towards apex; mesofemur with row of five to six relatively weak setae along hind edge in basal half (Fig. 11); mesotarsi similar to protarsi. Metatrochanter weakly pointed (Fig. 12); metafemur elongate, lacking spines; metatibia curved, widening towards apex; metatarsi elongate, basal segment longest, apical segment a little longer than fourth, segments 1 and 2 in combination about as long as others; claws weak.

Male. Antennae a little stouter; pro- and mesotarsi a little stouter. Median lobe of aedeagus quite broad, weakly narrowing in apical quarter, tip blunt; paramere broad, apical segment with broad apical lobe folded over basal portion of apical segment (Figs 8–10).

Etymology

Named after Challa Pastoral Station, the location of the calcrete area in which it occurs.

Remarks

Nirridessus challaensis is a moderately large species without a row of large punctures adjacent to the suture. It can be recognised by the row of five relatively weak (for *Nirridessus*) spines on the mesofemur, the relatively broad pro- and mesotarsi, and by the antenna which has segments—including segments 3, 4 and the apical one—of approximately the same length.

Nirridessus fridaywellensis sp. nov.
(Figs 15–21)

Types

Holotype: m. 'BES 8379, Bore at Shearing Quarters, Depot Springs Station,

27°55'50"S, 120°04'45"E, 26/6/00, coll W. F. Humphreys, S. Hinze' in spirit, WAM 27628.

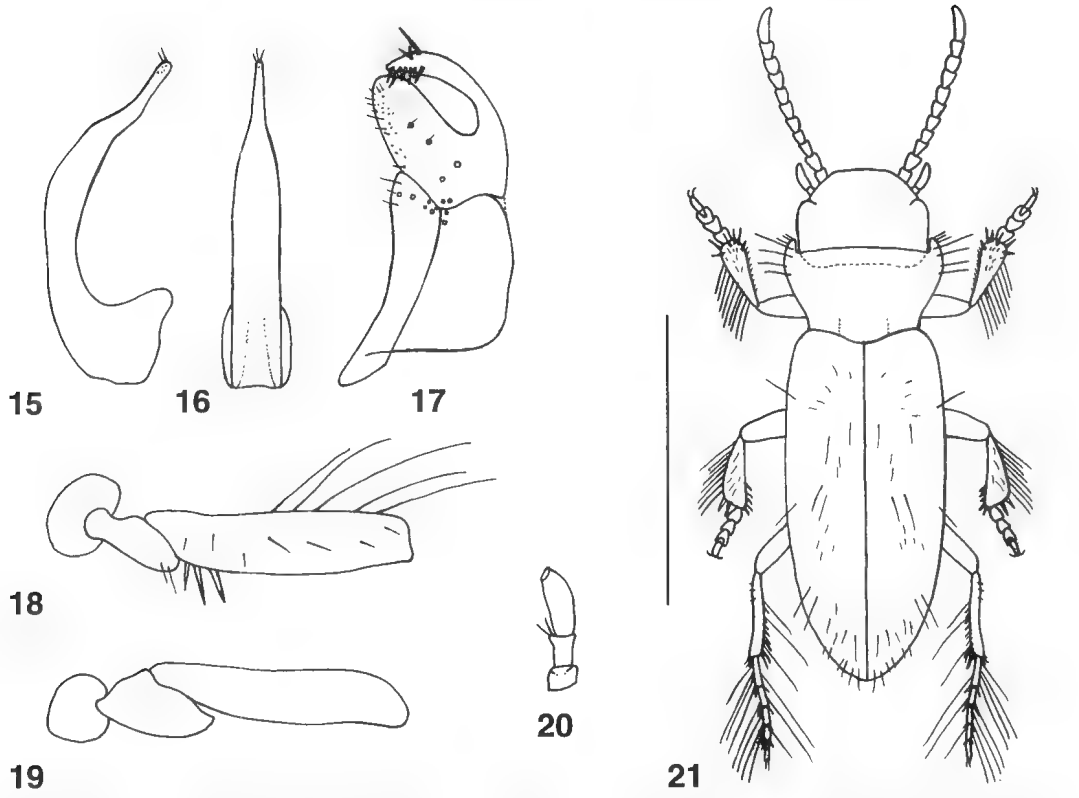
Paratypes: 2, as for holotype, 1 SAMA, 1 WAM 27629, slide mounted; 4, 'BES 8401, Site 425, Depot Springs, 28°03'00"S, 120°02'21"E, 28/6/00, coll W. F. Humphreys, S. Hinze', 2 SAMA, 2 WAM 27630–27631; 3,. 'BES 8406, Friday Well, Depot Springs, 28°03'36"S, 120°04'03"E, 28/6/00, coll W. F. Humphreys, S. Hinze', 2 SAMA, 1 WAM 27632, slide mounted.

Additional specimen: 1, f., 'BES 8374 Gums Well Depot Spring' SAMA. This specimen may also belong to this species but a male is needed to confirm the identification.

Description (number examined, 10)

Habitus. Length 1.7–1.8 mm; relatively flat, strongly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about quarter length of elytron.

Head. Relatively small, narrower than elytra; smooth, weakly reticulate, almost impunctate; subparallel in posterior half; sides with dark suture in middle near anterior edge. Antenna relatively stout; basal segment cylindrical, second large, oval, third segment almost as long, much narrower, narrowing towards base, next six subequal, apical segment about twice as long as penultimate; each segment, other than 1 and 4, with some very small setae on inside apically (Fig. 21). Maxillary palpus thin, elongate, apical segment large, a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side near tip, tip truncated. Labial palpus moderate,



FIGURES 15–21. *Nirridessus fridaywellensis*: 15, lateral view of central lobe of aedeagus; 16, ditto dorsal view; 17, paramere; 18, mesotrochanter and mesofemur; 19, metatrochanter and metafemur; 20, labial palpus; 21, dorsal view. Scale bar represents 1 mm.

apical segment longer than penultimate, tip weakly bifid, penultimate segment with small papilla near tip bearing two setae (Fig. 20).

Pronotum. Narrower than elytra; anteriolateral angles projecting strongly forward; base strongly narrowed, posterolateral angles acute; smooth, with very sparse, very weak punctures more numerous towards the front margin; moderately reticulate; basal plicae absent; with row of long setae laterally, denser towards front.

Elytra. Not fused, lacking inner ridges; elongate, widest behind middle, smooth, evenly covered with sparse very small punctures, central row of serial punctures hard to trace; some setiferous micropunctures near apex and along sutural line, very sparse or lacking at base; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; moderately reticulate. Epipleuron broad in anterior fifth, then rapidly narrowing to be virtually absent over rest of elytron.

Ventral surface. Prothoracic process strongly narrowed between coxae, not reaching metasternum, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply triangular in front in midline, wings very narrow, broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate; moderately reticulate; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines distinct, ventrites 3 to 5 mobile, virtually impunctate except for ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively narrow, edges straight, evenly diverging, widest at apex where it is about 4x its basal width; protarsi little expanded, first segment oval, second segment as wide as about one-half length of first, third segment as long as first and as wide, deeply bifid, fourth segment very small and hidden within lobes of third

segment, apical segment narrow, cylindrical, about twice length of third, segments 1 to 3 with a few adhesive setae; claws short and simple. Mesotrochanter elongate oval with a few fine setae on inner edge; mesofemur with three strong setae/spines on hind edge close to base (Fig. 18); mesotarsi similar to protarsi. Metatrochanter weakly pointed (Fig. 19); metafemur elongate, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, basal segment longest, apical segment a little longer than fourth, segments 1 and 2 in combination about as long as others; claws weak.

Male. Antennae a little stouter; pro- and mesotarsi a little stouter. Median lobe of aedeagus relatively wide, narrowing rapidly in apical quarter into a long thin tip; paramere broad, apical segment with narrow, curved, apical lobe not, or only marginally, overlapping basal portion of apical segment (Figs 15–17).

Etymology

Named after one of the wells in which it occurs.

Remarks

Nirridessus fridaywellensis is a small *Nirridessus* with elytron lacking a row of serial punctures. It can be separated from similar species by the lack of pronotal plicae, three spines on the mesofemur and the form of the aedeagus.

Nirridessus masonensis sp. nov.
(Figs 22–28)

Types

Holotype: m. 'BES 8357, Salt Well, Lake Mason Station, 27°32'24"S, 119°37'27"E, 24/6/00, coll W. F. Humphreys, S. Hinze', slide mounted, WAM 27633.

Paratypes: 36, as for holotype, 16 SAMA, 20 WAM 27634–27653; 13, as for holotype except 'BES 8356', WAM 27654–27666; 1, as for holotype except 'BES 8354', WAM 27667; 8, as for holotype except for 'BES 8351', SAMA.

Description (number examined, 59)

Habitus. Length 1.6–1.9 mm; relatively flat, moderately strongly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, a bit over half length of elytron (Fig. 28).

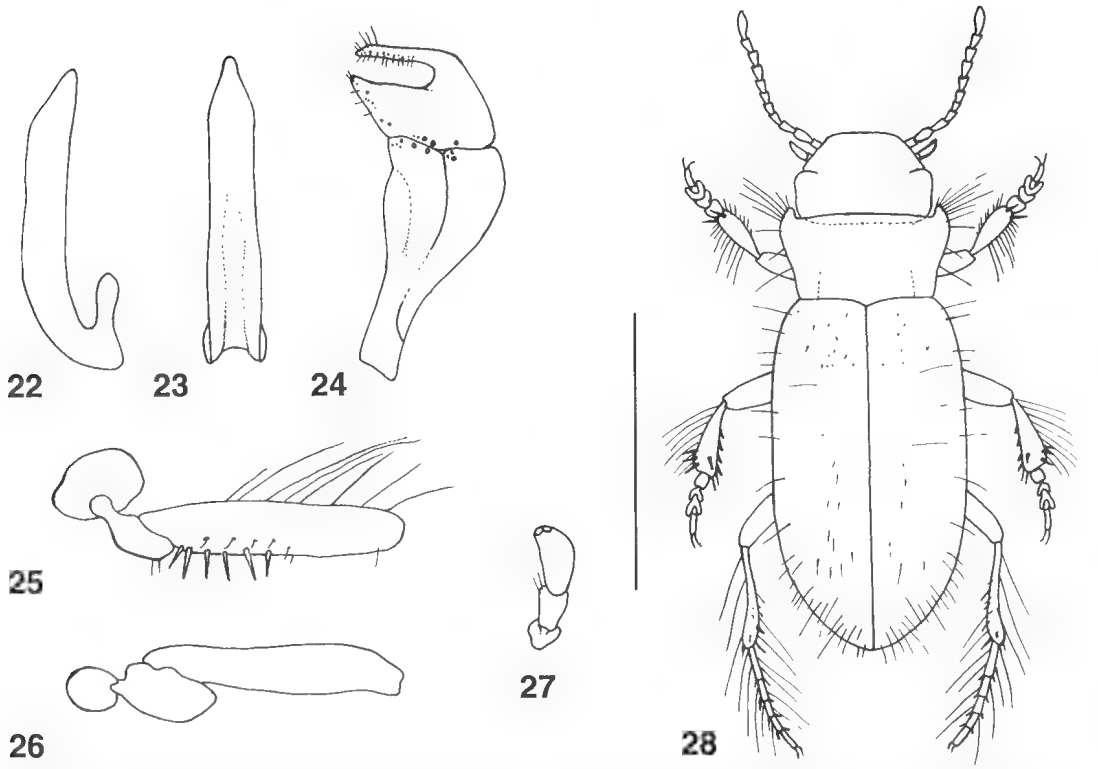
Head. Narrower than elytra; smooth, reticulation very weak, a few sparse small setae-bearing punctures; subparallel in posterior half; eye remnant reduced to single dark suture in middle near anterior edge. Antenna relatively stout; basal segment cylindrical, second large, oval, third segment shorter, narrower, narrowing towards base, fourth smaller, more parallel-sided, next six subequal, apical segment about twice length of penultimate; each segment, except segments 1 and 4, with some very small setae on inside apically (Fig. 28). Maxillary palpus elongate, apical segment large, a little longer than segments 1 to 3 combined, a diagonal row of long setae on outer side, tip truncated. Labial palpus moderate, apical segment longer than penultimate, tip weakly bifid, penultimate segment with small bulge near tip bearing two setae (Fig. 27).

Pronotum. A little narrower than elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles acute; smooth, with sparse, weak punctures more numerous towards front margin; basal plicae weak, reaching to about halfway along pronotum, slanting slightly inwards; with row of long setae laterally, denser towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures, a row of serial punctures in middle of each elytron; setiferous micropunctures in basal fifth and near apex; row of long setae near lateral edge; a few additional larger punctures with long setae, more frequent towards sides. Epipleuron broad in anterior fifth, then rapidly narrowing to be virtually absent over rest of elytron.

Ventral surface. Prothoracic process strongly narrowed between coxae, not reaching metasternum, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly triangular in front in midline, wings very narrow, broadly rounded in midline behind. Metacoxal plates large, metacoxal lines very weak, widely spaced, reaching to about halfway to metasternum, diverging weakly in anterior third; virtually without punctures except for a few near midline; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural line distinct in inner half, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively narrow, inner edge straight, outer edge bowed, widest past middle where it is about 3x its basal width; protarsi weakly expanded, first segment reticulate, second segment as broad, about one-half length of first,



FIGURES 22–28. *Nirridessus masonensis*: 22, lateral view of central lobe of aedeagus; 23, ditto dorsal view; 24, paramere; 25, mesotrochanter and mesofemur; 26, metatrochanter and metafemur; 27, labial palpus; 28, dorsal view. Scale bar represents 1 mm.

third segment as long as first and as wide, moderately bifid, fourth segment very small and hidden within lobes of third segment, apical segment comparatively stout, cylindrical, about 1.5x length of third, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate-oval with one or two weak setae on inner edge; mesofemur with row of six to seven strong setae/spines along hind edge in basal half (Fig. 25); mesotarsi similar to protarsi. Metatrochanter bluntly pointed (Fig. 26); metafemur elongate, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, basal segment longest, apical segment a little longer than fourth, segments 1 and 2 in combination about as long as others; claws weak.

Male. Antennae a little stouter; pro- and mesotarsi a little stouter. Median lobe of aedeagus relatively wide, narrowing in apical quarter to blunt tip; paramere broad, apical segment with pronounced, narrow, apical lobe well separated from rest of apical segment (Figs 22–24).

Etymology

Named after the type location.

Remarks

Nirridessus masonensis is a small *Nirridessus* with the elytron lacking a row of large sutural punctures. It can be recognised by the relatively numerous well spread out spines on the mesofemur, obsolete lateral portion of the suture between the first and the second ventrite, and the long apical lobe to the paramere, which is well separated from the rest of the apical segment.

Nirridessus pinnaclesensis sp. nov.
(Figs 29–35)

Type

Holotype: m. 'BES 8397, Site 432, Pinnacles Station, 28°15'27"S, 120°07'37"E, 28/6/00, coll W. F. Humphreys, S. Hinze', slide mounted, WAM 27672.

Description (number examined, 1)

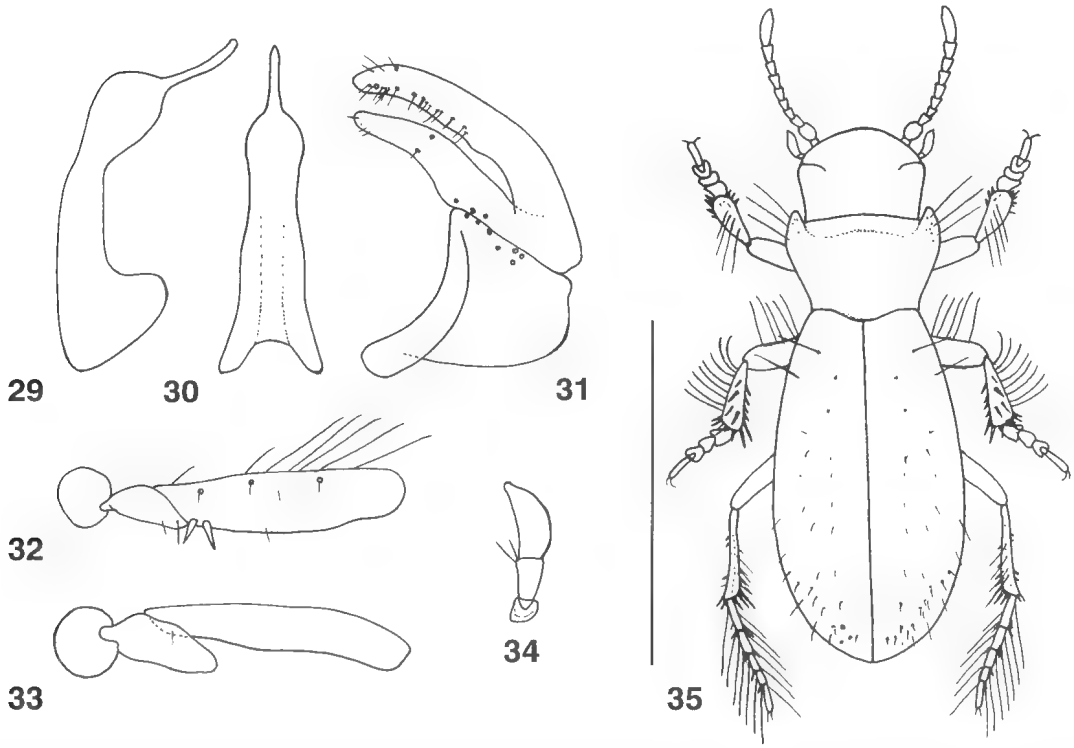
Habitus. Length 1.5 mm; relatively flat, strongly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about half length of elytron.

Head. Moderate, narrower than elytra; smooth, virtually without reticulation, virtually impunctate; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to broad dark suture in middle near anterior edge. Antenna stout; basal segment cylindrical, second almost round, third shorter, thinner, narrower at base, fourth about half length of third, next six subequal, apical segment twice as long as penultimate; each segment, except segments 1 and 4, with some very small setae on inside apically (Fig. 35). Maxillary palpus, elongate, apical segment large, a little longer than segments 1 to 3 combined, an oblique row of long setae on outer side towards tip, tip truncated. Labial palpus with apical segment longer than penultimate, tip weakly bifid, penultimate segment with small bulge near tip bearing two setae (Fig. 34).

Pronotum. About as wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles acute; smooth, virtually impunctate; basal plicae absent (or at least not traceable on mounted specimen); with some long setae laterally, denser towards front.

Elytra. Not fused, lacking inner ridges; elongate, widest behind middle, smooth, weakly reticulate, very sparsely covered with small punctures, row of serial punctures in centre of elytron; setiferous micropunctures at apex, base and near suture; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron broad in anterior fifth, then rapidly narrowing to be virtually absent over rest of elytron.

Ventral surface. Prothoracic process strongly narrowed between coxae, not reaching metasternum, apical half triangular, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply triangular in front in midline, wings very narrow, broadly rounded in midline behind. Metacoxal plates large, metacoxal



FIGURES 29–35. *Nirridessus pinnaclesensis*: 29, lateral view of central lobe of aedeagus; 30, ditto dorsal view; 31, paramere; 32, mesotrochanter and mesofemur; 33, metatrochanter and metafemur; 34, labial palpus; 35, dorsal view. Scale bar represents 1 mm.

lines long, moderate, widely spaced, reaching to about halfway to metasternum, weakly diverging; sparsely covered with small setae-bearing punctures; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines distinct, ventrites 3 to 5 mobile, very sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively broad, inner edges straight, widest past middle where it is about 3x its basal width; protarsi weakly expanded, first segment broadly oval, somewhat asymmetrical with outer side less expanded, second segment broad about one-half length of first, third segment as long and wide, quite deeply bifid, fourth segment small and hidden within lobes of third segment, apical segment narrow, cylindrical, about twice length of third, segments 1 to 3 with some adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae on inner edge; mesofemur with row of 2 very strong setae/spines on hind edge close to base (Fig. 32); mesotarsi less expanded than protarsi. Metatrochanter tip rounded (Fig. 33); metafemur elongate, row of small spines near inner edge; metatibia strongly curved, widening towards apex; metatarsi elongate, basal segment longest, apical segment a little longer than fourth, segments 1 and 2 in combination about as long as others; claws weak.

Male. Median lobe of aedeagus broad, apical quarter beak-like; paramere short, broad, apical segment formed into two long narrow lobes (Figs 29–31).

Etymology

Named after the Pinnacles Pastoral Station on which the specimens were found.

Remarks

Only one specimen is known of this small *Nirridessus*. Distinctive characters are the unusual beak-shaped central lobe to the aedeagus and two long lobes at the tip of the paramere, only two spines at the base of the mesofemur and short, stout antennae with a relatively long apical segment.

Nirripirti gen. nov.

Diagnosis/Description

Elongate—oval, relatively flat; eyeless; uniformly light testaceous; surface reticulate, meshes small, relatively even; punctures small, sparse; scutellum not visible dorsally. Pro- and mesotarsi pseudotetramenous; metatrochanters almost completely exposed, metafemur narrow, impunctate, metatibia relatively even in width. Pronotal process strongly arched, not reaching mesosternum; mesocoxae meeting. Male with one segmented parameres; central lobe of aedeagus simple.

Remarks

We place this genus in the Hydroporini on the strength of its relatively small size, lack of visible scutellum, straight even-width hind tibia, simple hind tarsi, simple even-sized hind claws, relatively narrow pronotal process, and single segmented parameres.

Its relationships within the Australian Hydroporini are not obvious. Its pseudotetramenous pro- and mesotarsi would seem to rule out *Sternopriscus* and *Necterosoma*; likewise, the shape of and lack of punctation on the metafemur would rule out *Megaporus, Antiporus, Tiporus* and *Sekaliporus*. By default as much as anything, we tentatively suggest that its sister genus could be *Paroster*. Its strong reticulation, elongate flattened shape and relatively simple aedeagus resemble some species in this genus but other characters, such as the elongate hind legs and lack of a basal epipleural stria on the elytra, negate any obvious relationship. A proper cladistic study, coupled with biochemical studies, will be needed to adequately determine its relations with other Australian genera.

Etymology

Western Desert Language; Nirri-nirri, beetle and pirti, well/shaft.

Type species

Nirripirti hinzeae sp. nov.

Nirripirti hinzeae sp. nov.

Types

Holotype: m. 'BES 8404, Friday Well, Depot Springs, 28°03'36"S, 120°04'03"E, 28/6/00, coll W. F. Humphreys, S. Hinze' in spirit, WAM 27673.

Paratypes: 3, as for holotype, WAM 27674–27676; 16, 'BES 8405, Friday Well, Depot Springs, 28°03'36"S, 120°04'03"E, 28/6/00, coll W. F. Humphreys, S. Hinze', 10 SAMA, 6 WAM 27677–27682.

Description (number examined, 20)

Habitus. Length 2.8–3.0 mm; elongate, relatively flat, slightly depressed in sutural region weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

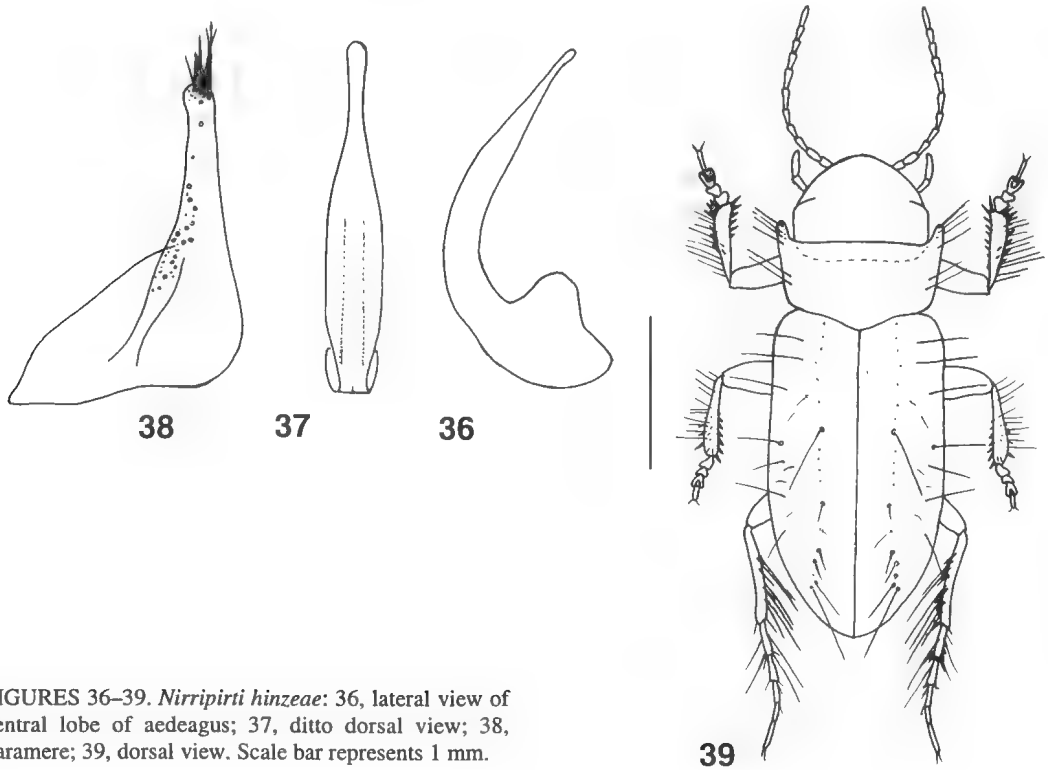
Head. Large, nearly as wide as elytra; smooth, moderately strong reticulation with small even meshes, virtually impunctate except a few near antennae bases; subparallel in posterior half; eye remnant reduced to a dark suture in middle near anterior edge. Antennal segments 3 to 5 thinner than rest, apical segment a bit longer and narrower than penultimate, each segment with some very small setae on inside apically (Fig. 39). Maxillary palpus elongate, apical segment longer than penultimate segment, some long setae towards apex of segments. Labial palpus with apical two segments subequal, tip weakly bifid.

Pronotum. Narrower than elytra; anteriolateral angles projecting strongly forward; base moderately narrowed, posterolateral angles obtuse; quite strongly reticulate, virtually impunctate except towards front margin; some long setae at edge towards front.

Elytra. Not fused, lacking inner ridges; elongate, widest behind middle, smooth, covered with fine reticulation; a few scattered small punctures, several rows of widely spaced small punctures; setiferous micropunctures at base, apex and along suture line, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron very weakly differentiated from rest of elytron, broad in anterior quarter, then gradually narrowing to middle, virtually absent over rest of elytron.

Ventral surface. Prothoracic process strongly narrowed between coxae, not reaching metasternum, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly pointed in front in midline, wings very narrow, rather narrowly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines distinct in inner half, indistinct laterally, ventrites 3 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae.

Legs. Profemur with small peg-like structure on



FIGURES 36–39. *Nirripirti hinzeae*: 36, lateral view of central lobe of aedeagus; 37, ditto dorsal view; 38, paramere; 39, dorsal view. Scale bar represents 1 mm.

hind edge adjacent to protrochanter; protibia narrow, widest past middle where it is about 3x its basal width; protarsi expanded, first segment broadly triangular, second segment about one-half length of first, third segment as long as first, deeply bifid, fourth segment very small and hidden within lobes of third segment, apical segment narrow, cylindrical, about length of third, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four to five strong setae/spines along hind edge in basal half; mesotarsi similar to protarsi. Metatrochanter elongate/oval; metafemur elongate, lacking spines; metatibia weakly curved, approximately the same width throughout; metatarsi elongate, basal and apical segments longest, subequal, segments 1 and 2 in combination much shorter than others; segments 2 to 5 without spines other than at apex; claws weak.

Male. Little difference from female. Median lobe of aedeagus narrowing rapidly in apical quarter; paramere broad at base, apical half thin, tip with a bunch of long setae. (Figs 36–38).

Etymology

Named after Susan Hinze, the co-collector of the specimens.

Discussion

Site characteristics and associated fauna

The material treated here represents the results of sampling from 89 sites, of which 44 were narrow tube bores and 45 were open pastoral wells. Thirteen of these sampling sites yielded Dytiscidae, seven from wells and six from bores (Fig. 40). Both Amphipoda and Ostracoda were taken from 19 sites, and Copepoda (cyclopoid and harpacticod) from 12 sites. All Dytiscidae were taken from calcrete aquifers. The dytiscids occur in a stygal assemblage that includes other dytiscid

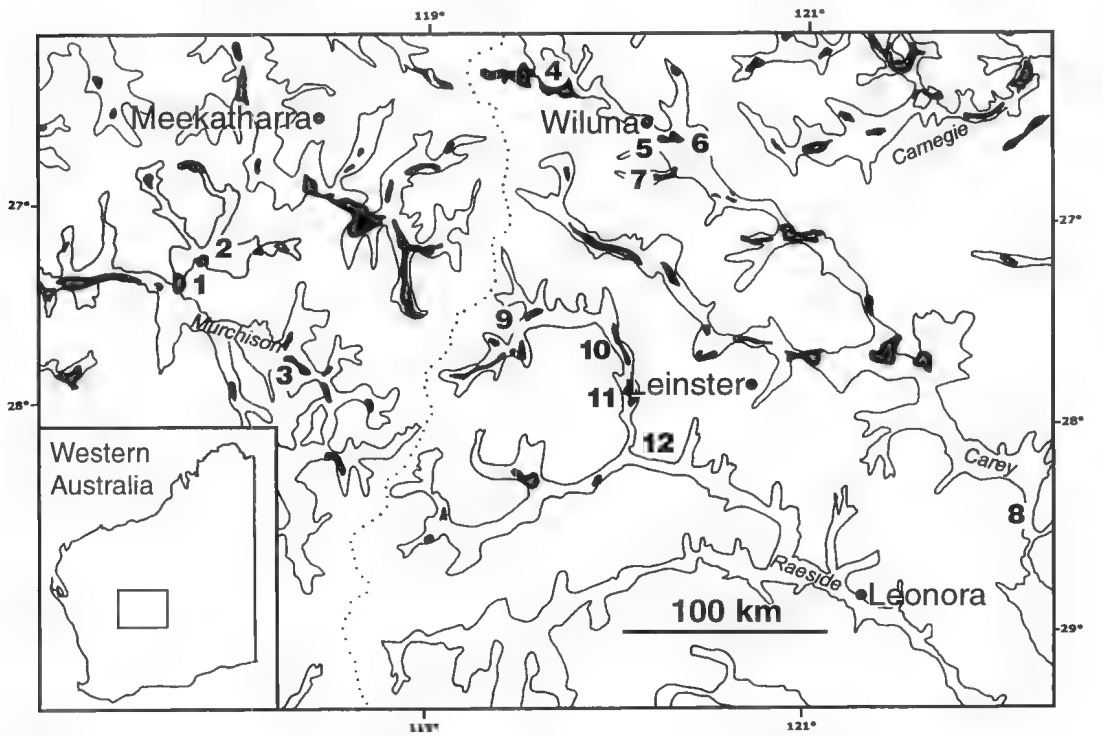


FIGURE 40. Map showing the distribution of stygobitic species of dytiscids in Australia. Numbers denote: 1, Austin Downs; 2, Cue; 3, Challa north; 4, Paroo; 5, Lake Violet; 6, NE Lake Way; 7, Hinkler Well; 8, Mount Windarra; 9, Lake Mason north; 10, Depot Springs north; 11, Depot Springs south; 12, Pinnacles. Outlined areas denote undifferentiated sediments in the palaeodrainage channels, while shaded areas denote calcrete. The northerly trending dotted line denotes the divide between the Indian Ocean and inland drainages (Beard 1998). Drawn from Geological Survey (1989).

TABLE 1. Taxa taken from the same wells as the dytiscid species

Dytiscid species	Sympatric taxa
Nirridessus challaensis	Amphipoda, Ostracoda, Copepoda, verms
Nirridessus fridaywellensis	*Nirripirti hinzeae*, Amphipoda, Ostracod, Copepoda, Bathynellacea, verms
Nirridessus masonensis	*Tjirtudessus raesideensis*. Amphipoda, Copepoda
Nirridessus pinnaclesensis	–
Tjirtudessus raesideensis	*Nirridessus masonensis*. Amphipoda, Copepoda
Nirripirti hinzeae	*Nirridessus fridaywellensis*. Amphipoda, Ostracoda, Copepoda.

species, amphipods, bathnellid syncarids, ostracods, cyclopoid and harpacticod copepods, and phreodrilid oligochaetes whose diversity has yet to be examined (Table 1). In other calcrete aquifers of the Western Shield of Australia, sympatry of congeners of various crustaceans is common (Bradbury 2000).

Water quality

The electrical conductivity of the water from which the Dytiscidae were recorded varied from 3.9 to 12.3 mS/cm, a salinity of approximately 2.3–7.3 g/L total dissolved solids (Table 2). While these waters are saline, they do not approach the high salinity, around 22 g/L, found near Lake Way (Watts & Humphreys 2000). However, the surface water may have been diluted by fresh water owing to unusually high rainfall in the six months prior to sampling; shallow calcrete aquifers are responsive to periodic recharge through the karst and may exhibit marked changes in both water level and salinity (Watts & Humphreys 2000). The pH and oxygen levels were within the range previously recorded for the stygobit Dytiscidae (Watts & Humphreys 2000).

Distribution

The general geological, climatic and biogeographical setting of the fauna discussed here is described elsewhere (Humphreys 1999, 2001; Watts & Humphreys 1999, 2000). Dytiscid specimens were collected from five separate calcrete deposits (Table 3): 1, Challa north; 2, Lake Mason north; 3, Depot Springs north; 4, Depot Springs south; and 5, Pinnacles. Site 1 is located in the Austin palaeodrainage that drains towards the Indian Ocean and is part of the upper Murchison catchment lying to the east of Lake Austin. The other sites were from the inland-draining Raeside palaeodrainage that lies to the south of the Carey palaeodrainage, from which it has been entirely separated since at least the

TABLE 2. Physicochemical measurements of water at some dytiscid sites

Date	Conductivity (mS/cm)	Temp (°C)	pH	O_2 (%)	Depth to/of water (m)	Dytiscids present
Friday Well						
28/6/00	5.2	15.1	7.89	39%	2.5/1	*Nirripirti hinzeae* sp. nov. *Nirridessus fridaywellensis* sp. nov.
Salt Well, Lake Mason						
24/6/00	12.3	18	8.00	–	5.5/0.56	*Nirrid. masonensis* sp. nov. *T. raesidensis* sp. nov.
Shearing Quarters Bore, Depot Springs						
26/6/00	6.8	22	7.38	–	1.5/9.5	*Nirrid. fridaywellensis* sp. nov.
Site 425, Depot Springs						
28/6/00	5.5	25	–	–	2.7/10	*Nirrid. fridaywellensis* sp. nov.
Nyung well, Challa Station						
22/6/00	3.9	20.4	7.67	39%	4/2	*Nirrid. challaensis* sp. nov.
Site 432, Pinnacles Station						
28/6/00	11.4	24.5	7.62	–	4.5/36	*Nirrid. pinnaclesensis* sp. nov.

TABLE 3. The distribution of stygal species of dytiscids amongst discrete calcrete bodies (1–12) in the Yilgarn district of Western Australia. The separate palaeodrainage systems (A–C) and the Indian Ocean and interior drainages are indicated. Numbers denote the locations in Fig. 40. Common superscripts 1–6 denote sympatric species

Calcreted body	Genus *Tjirtudessus*	*Nirridessus*	*Kintingka*	*Nirripirti* gen. nov.
A. Western drainage: Austin palaeodrainage				
1 Austin Downs	–	*bigbellensis*	–	–
2 Cue	*magnificus*[2]	*cueensis*[2]	–	–
3 Challa north	–	*challaensis* sp. nov.	–	–
B. Eastern drainage: Carey palaeodrainage				
4 Paroo	*eberhardi*[3]	*pulpa*[3]	*kurutjutu*[3]	–
5 Lake Violet	–	undescribed sp.	–	–
6 NE Lake Way	*hahni*	*morgani*	–	–
7 Hinkler Well	–	*hinkleri*	–	–
8 Mount Windarra	–	*windarraensis*[4] *lapostaae*[4]	–	–
C. Eastern drainage: Raeside palaeodrainage				
9 Lake Mason north	*raesidensis* sp. nov.[5]	*masonensis* sp. nov.[5]	–	–
10 Depot Springs north*	–	*fridaywellensis* sp. nov.	–	–
11 Depot Springs south*	–	*fridaywellensis* sp. nov.[6]	–	*hinzeae* sp. nov.[6]
12 Pinnacles	–	*pinnaclesensis* sp. nov.	–	–

* Depot Springs north and Depot Springs south are separate expressions of calcrete at the surface but are considered to be a continuous calcrete body by the pastoralist (M. Cavallaro, personal communication, 26 June 2000).

Cretaceous (Humphreys 1999 in press), and in which there are many stygal dytiscid taxa (Watts & Humphreys 1999, 2000). The distribution of taxa by calcrete body is shown in Table 3.

As found previously (Watts & Humphreys 1999, 2000), each species is restricted to a single calcrete region (Table 3) and half the sites contain sympatric non-congeneric Dytiscidae. Owing to the sparse sampling of many species, a more detailed sampling of these aquifers would be expected to increase the number of sites containing Dytiscidae, and may show species to be more widely distributed than currently found.

The prediction of a much richer fauna of stygobitic Dytiscidae in Western Australia (Watts and Humphreys 2000) has been fulfilled. Since only about 10% of the major calcrete deposits in the palaeodrainage channels of Western Australia (Humphreys 1999) have been sampled for stygofauna, it is likely that numerous additional subterranean Dytiscidae, as well as other stygobitic taxa, especially Crustacea, remain to be discovered in the northern Yilgarn region.

This paper reaffirms that the dytiscid fauna of the Northern and Eastern Goldfields areas of the Yilgarn is uniquely diverse by world standards. Molecular work has commenced to determine the origins and evolution of this diverse stygofauna.

Acknowledgments

It is a pleasure to acknowledge the assistance of Susan Hinze in the field sampling and sorting; Julianne Waldock for laboratory processing; Rob Gutteridge (Adelaide) for drawing the illustrations. We thank Kevin Morgan and Philip Commander for access to information about bore locations and for unstinting access to their knowledge of the Yilgarn aquifers. Information about the locations of, and access to, sampling sites was kindly provided by many pastoralists in the region.

References

BEARD, J. S. 1998. Position and development history of the central watershed of the Western Shield, Western Australia. *Journal of the Royal Society of Western Australia* **81**: 157–164.

BRADBURY, J. H. 2000. Western Australian stygobitic amphipods (Crustacea: Paramelitidae) from the Mt Newman and Millstream regions. *Records of the Western Australian Museum*, Supplement No. **60**: 1–102.

GEOLOGICAL SURVEY 1989. Hydrogeological map of Western Australia, 1:2,500,000. Geological Survey of Western Australia: Perth.

HUMPHREYS, W. F. 1999. Relict stygofaunas living in sea salt, karst and calcrete habitats in arid north-western Australia contain many ancient lineages. Pp. 219–227 *in* 'The Other 99%. The Conservation and Biodiversity of Invertebrates.' Eds W. Ponder & D. Lunney. Transactions of the Royal Zoological Society of New South Wales: Mosman, NSW.

HUMPHREYS, W. F. 2001. Groundwater calcrete aquifers in the Australian arid zone: the context to an unfolding plethora of stygal biodiversity. *Records of the Western Australian Museum* Supplement No. 64: 63–83.

POORE, G. C. B. & HUMPHREYS, W. F. 1998. First record of Spelaeogriphacea from Australasia: a new genus and species from an aquifer in the arid Pilbara of Western Australia. *Crustaceana* **71**: 721–742.

SPANGLER, P. J. 1986. Insecta: Coleoptera. Pp. 622–632 *in* 'Stygofauna. A Faunistic, Distributional and Ecological Synthesis of the World Fauna inhabiting Subterranean Waters (Including the Marine Interstitial)'. Ed. L. Botosaneau. E. J. Brill: Leiden.

WATTS C. H. S. & HUMPHREYS W. F. 1999. Three new genera and five new species of Dytiscidae (Coleoptera) from underground waters in Australia. *Records of the South Australian Museum* **32**(2): 121–142.

WATTS C. H. S. & HUMPHREYS, W. F. 2000. Six new species of *Nirridessus* Watts and Humphreys and *Tjirtudessus* Watts and Humphreys (Dytiscidae: Coleoptera) from underground waters in Australia. *Records of the South Australian Museum* **33**: 127–144.